Soil greenhouse gas exchange in the year after plantation harvesting

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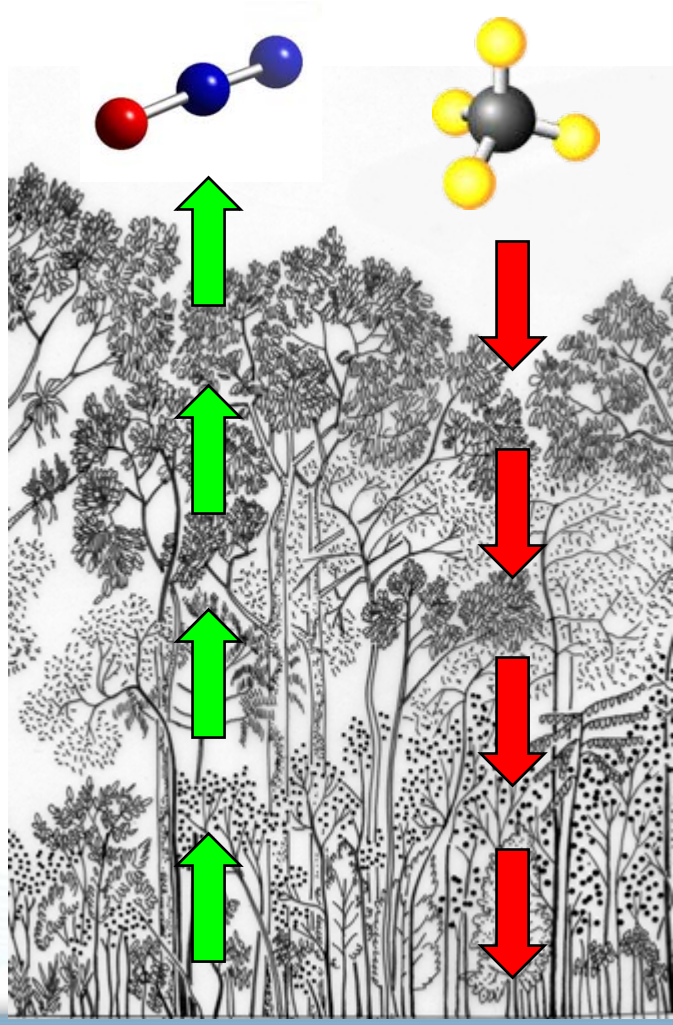
New forests and GHG exchange

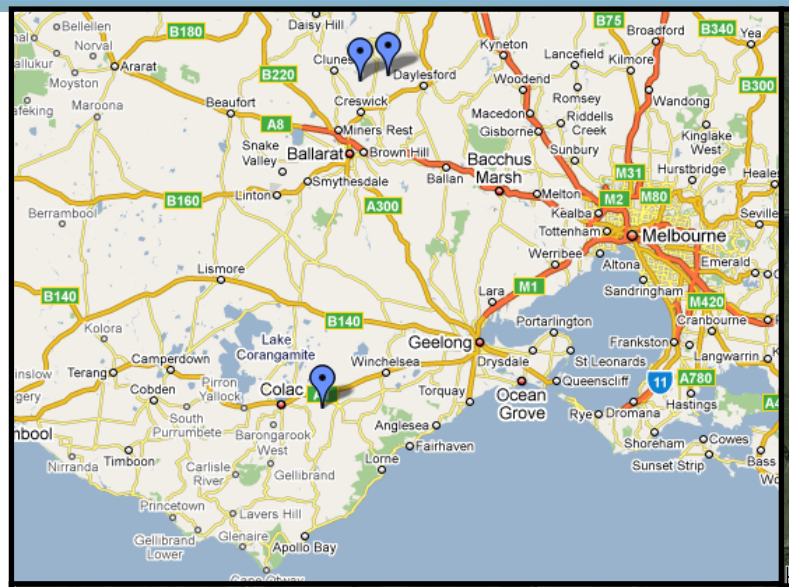
- Planting new forests on agricultural land is expected to be a net C sequestration benefit.
- New plantation forests can provide additional GHG benefits through reduced soil N_2O emissions and increased soil CH_4 uptake (Livesley et al., 2009, GCB).
- What will happen to soil-atmosphere GHG exchange during and in the year(s) after plantation harvest disturbance?

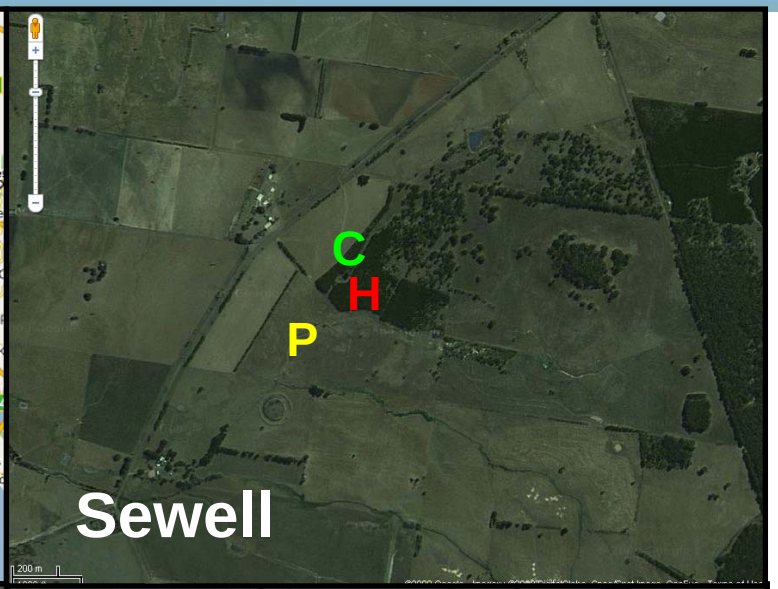
Harvesting & CH_4 / N_2O exchange

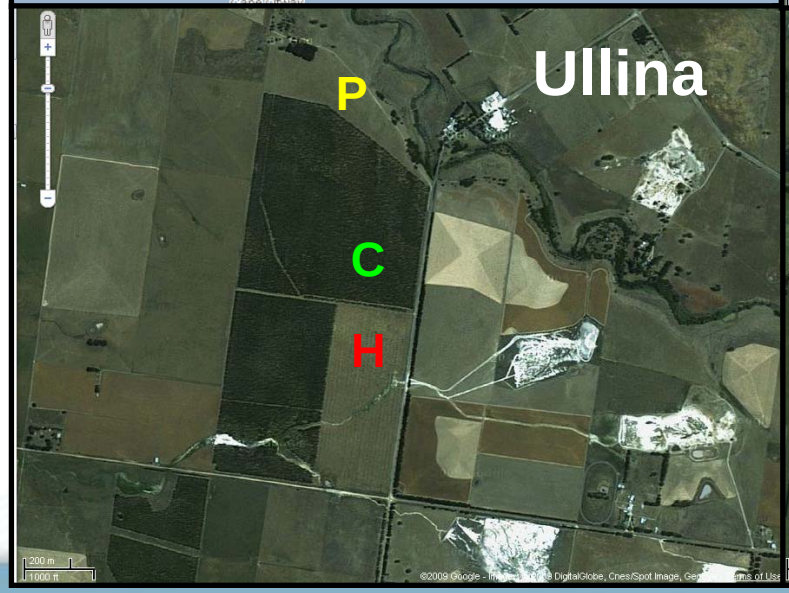
- Forest soils are the most important terrestrial CH_4 sink.
- Harvest disturbance can reduce forest soil CH_4 uptake *(Morishita et al., 2005)* and lead to 'hot-spots' of CH_4 production *(Castro et al., 2000).*
- Australian forest soils are a small N_2O source *(Fest et al., 2009; Livesley et al., 2009).* because of tight nutrient cycling and soil-litter C:N ratios.
- Harvesting disturbs microclimate, organic inputs, rhizosphere and microbial processes – which may reduce nutrient cycling efficiency and increase N_2O emissions.

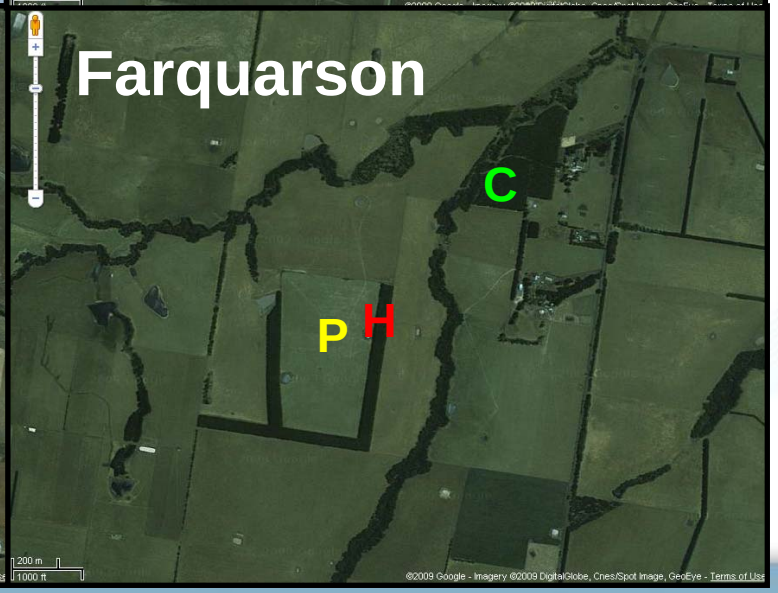


Field site locations



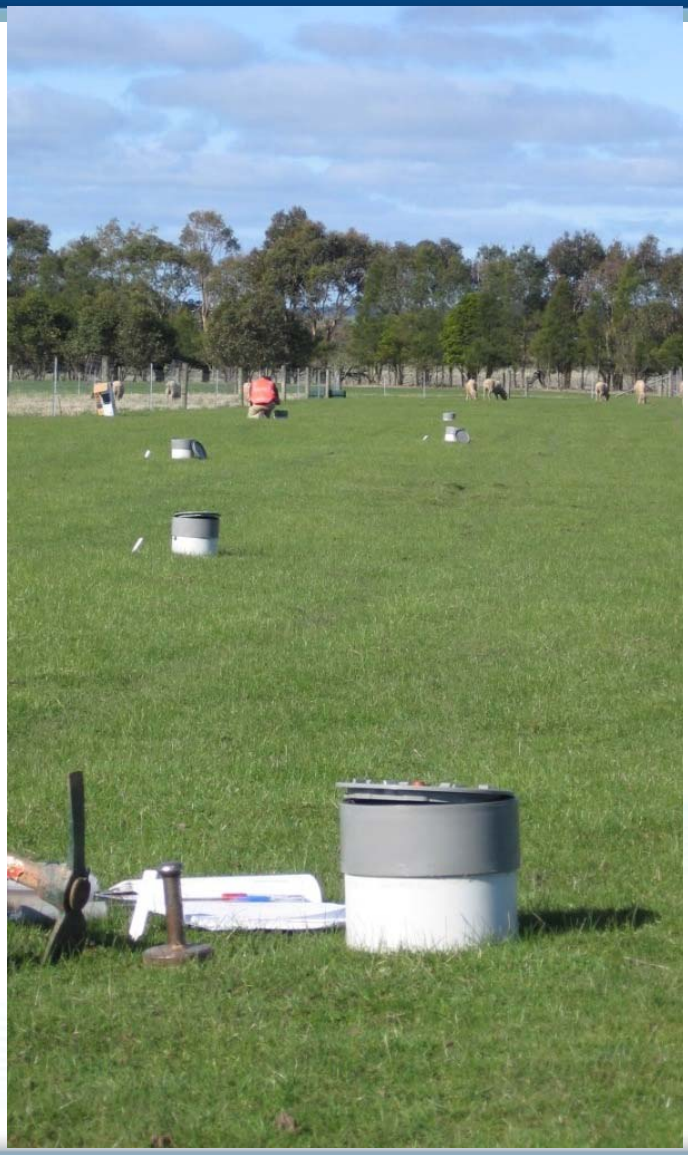




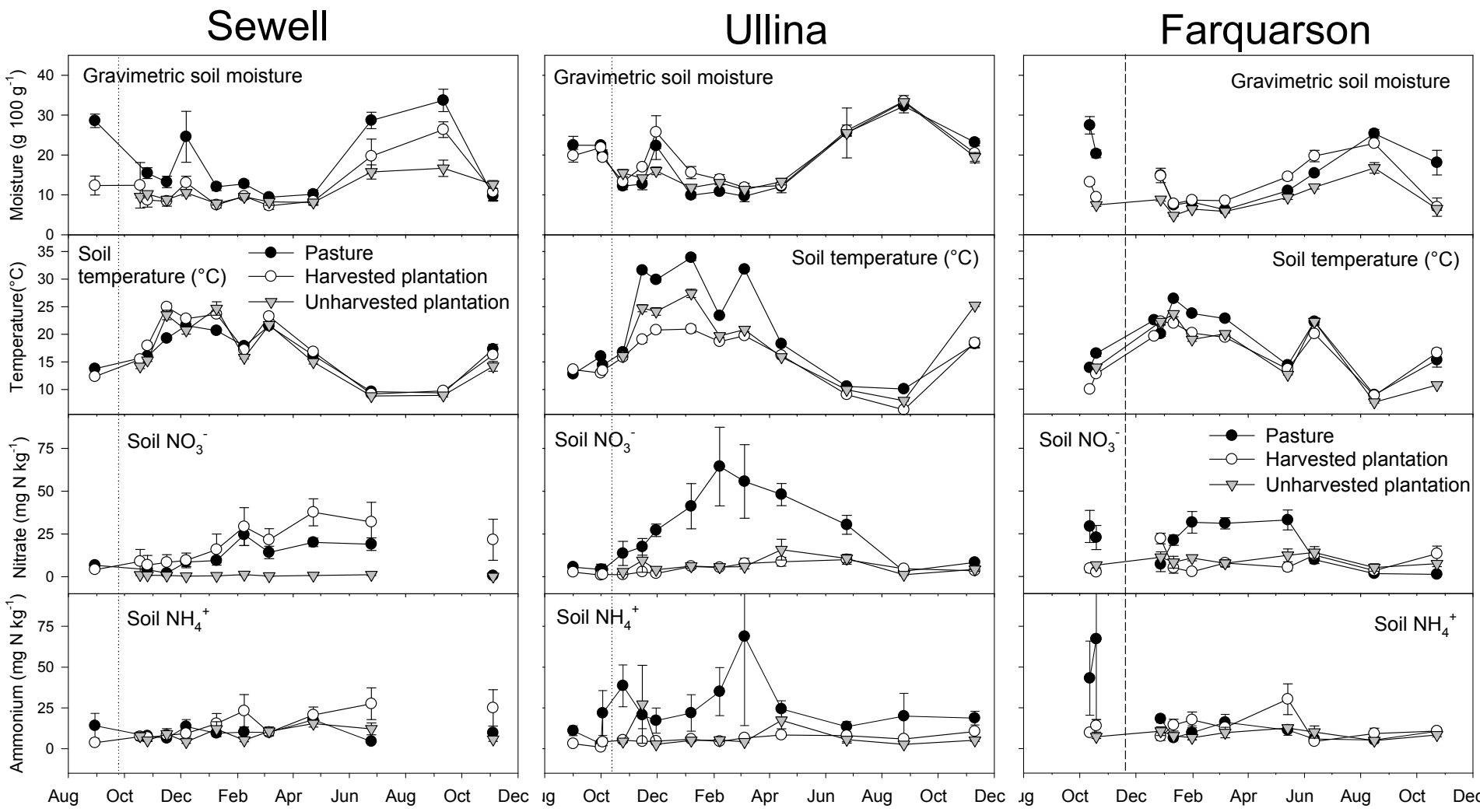


Method

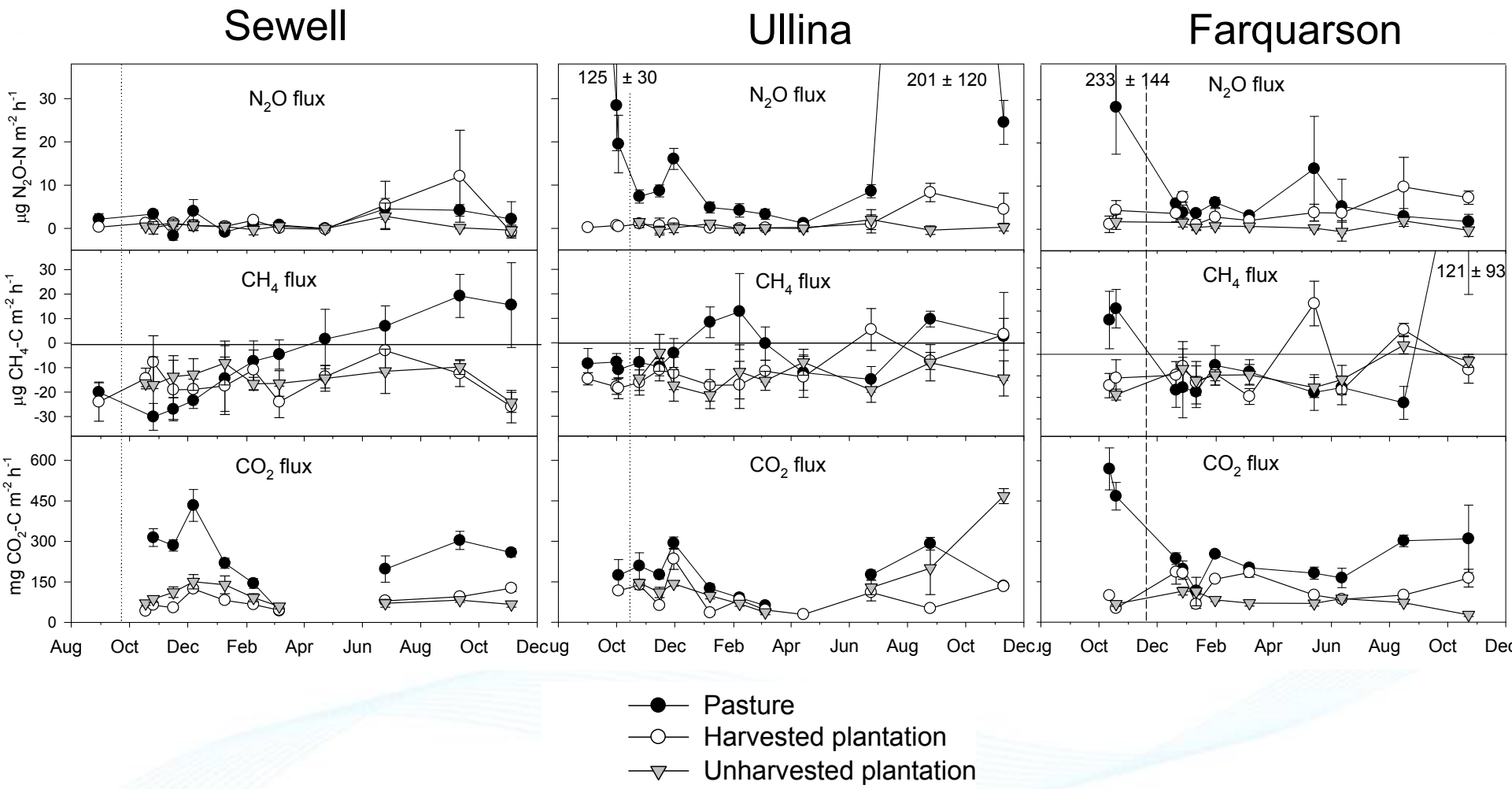
- BACI design (plus pasture)
- 5 chambers per land-use
- 30 m between chambers (in 2 x 2 m plots)
- 0, 15, 30, 45 minute sampling interval
- Soil sampled 0-10 cm for water & N content.
- Litter sampled for mass & C:N ratio



Soil environmental properties



Soil N_2O, CH_4 and CO_2 flux

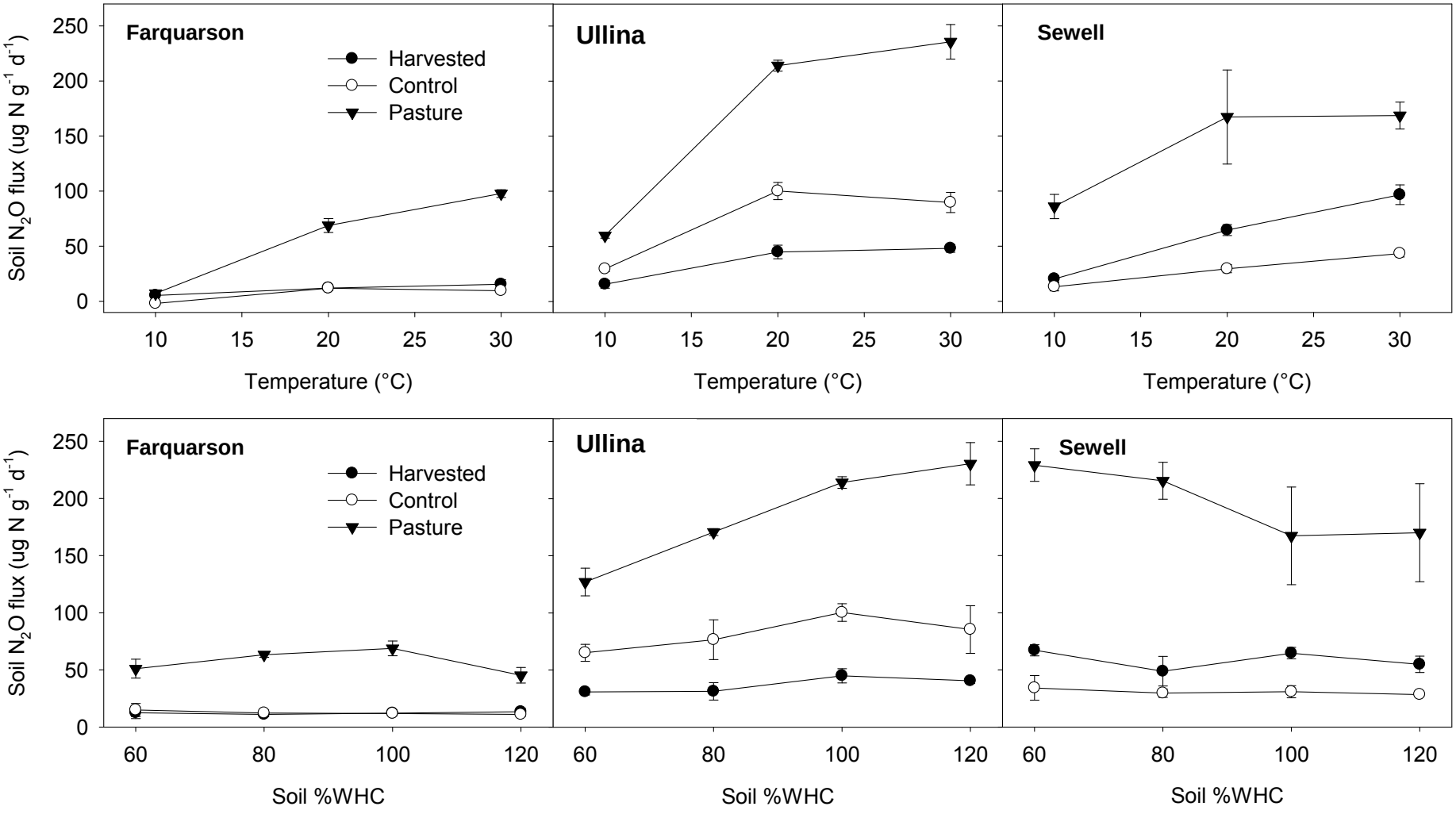


Flux & soil condition correlations

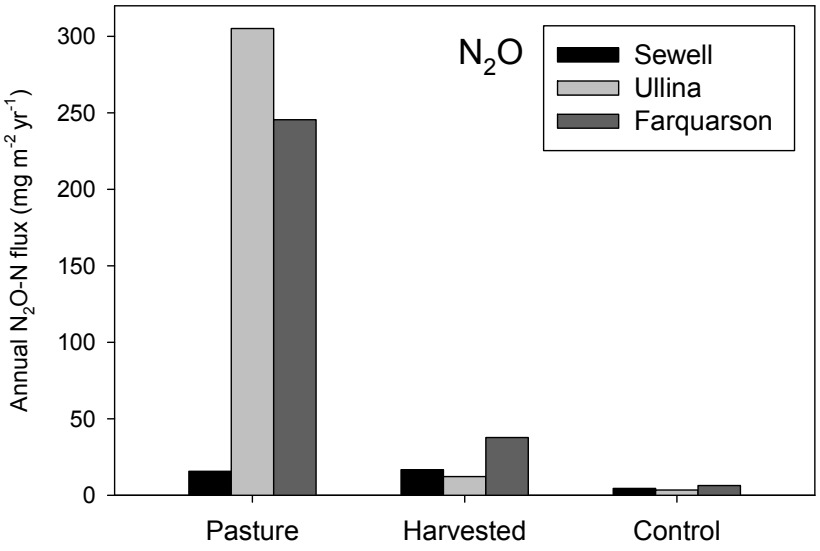
Pearson correlation coefficients

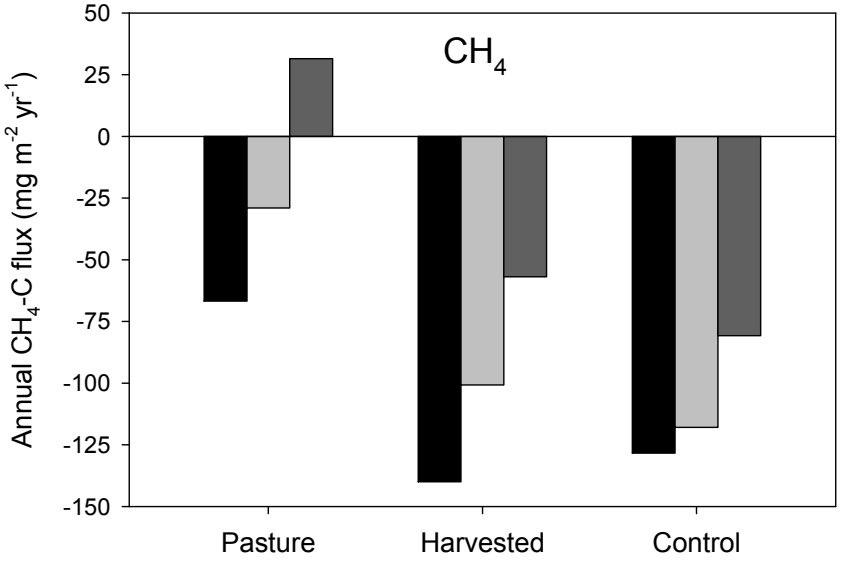
		N_2O flux (µg m^2 hr^{-1})				**CH_4 flux** (µg m^2 hr^{-1})				**CO_2 flux** (mg m^2 hr^{-1})			
Site	**Landuse**	Moisture	Temp.	NO_3^-	NH_4^+	Moisture	Temp.	NO_3^-	NH_4^+	Moisture	Temp.	NO_3^-	NH_4^+
Sewell	Pasture	.35 **	-.25 *	–	–	–	-.35 *	–	–	.38 **	-.63 **	–	–
Sewell	Control	–	–	–	–	–	–	–	–	–	.45 **	–	–
Sewell	Harvested	.25 *	–	–	–	–	–	–	–	.31 *	–	–	.33 *
Ullina	Pasture	.61 **	-.45 **	-.40 **	–	–	–	–	–	.57 **	-.35 **	-.42 **	–
Ullina	Control	–	–	–	–	–	–	–	–	.33 *	–	–	–
Ullina	Harvested	–	–	–	–	–	–	–	–	.31 *	–	-.49 **	–
Farquarson	Pasture	–	–	.29 *	.31 *	–	–	–	–	.59 **	-.75 **	-.32 *	–
Farquarson	Control	–	–	–	–	–	–	.27 *	–	–	–	–	.33 *
Farquarson	Harvested	–	–	–	-.33 **	–	-.27 *	–	–	–	.40 **	–	–

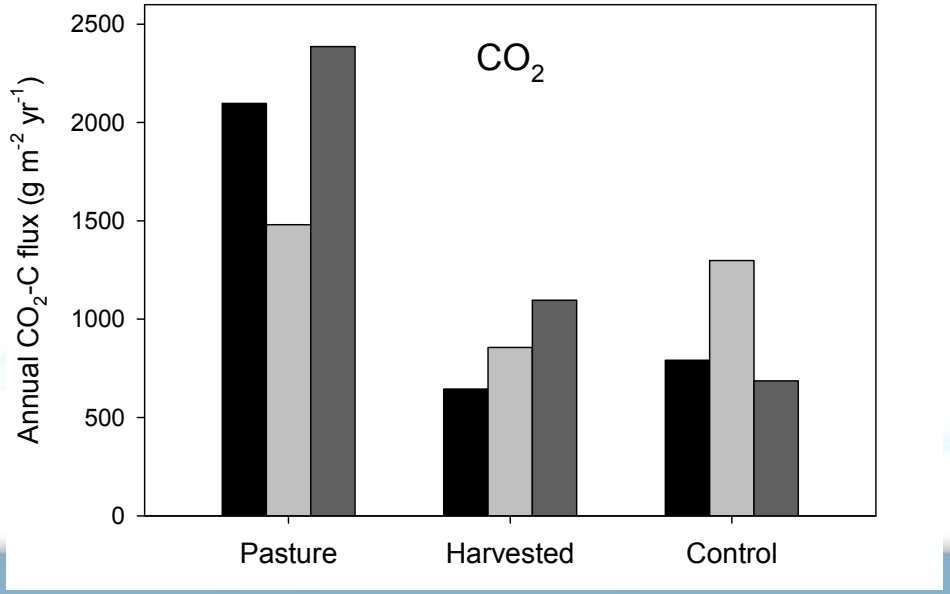
Soil N_2O flux - %WHC and °C



Annual flux estimates







Conclusions

- Large N_2O emissions from unfertilised, unirrigated pasture systems as compared to new forest systems.
- Increase in soil N_2O emissions in the year after harvest, but small emissions in comparison to pasture.
- No clear difference in soil CH_4 uptake before and after (1 yr) plantation harvest event.
- No clear difference in soil CO_2 uptake before and after (1 yr) plantation harvest event.

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